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(54) Anaesthetic delivery system

(57) An anaesthetic delivery system comprises a ventilation means (1) having an inspiration gas pathway (13,3,7) for conducting inspiration gas to a patient (4) and an expiration gas pathway (8,3,12) for conducting expiration gas away from the patient (4); and a filter element (5) serially connected to both the inspiration and the expiration gas pathways being adapted to retain an anaesthetic from expiration gas passing there through and to release retained anaesthetic into inspiration gas passing there through characterised in that there is further provided a supply of flushing gas (1,21) communicable with the filter element (5) to flush the retained anaesthetic from the system without passing to the patient (4).

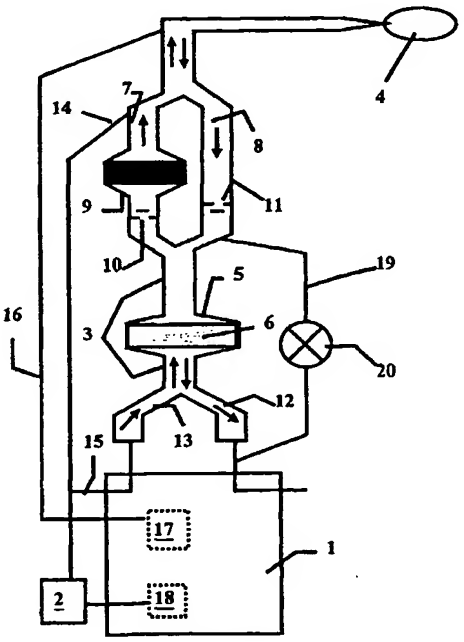

FIG. 1

EP 0 972 534 A2

Description

[0001] The present invention relates to an anaesthetic delivery system and in particular to one in which gaseous anaesthetic expired by a patient is re-used by introducing it into gas intended to be inspired by the patient.

[0002] A patient anaesthetic delivery system is described in the patent US 5,471,979 wherein fresh respiration gas passes through an adsorption filter to take up adsorbed anaesthetic, collected from gas passing there through and which has been expired by the patient. In this manner expensive anaesthetic, which would otherwise be lost, may be re-used. This system comprises a common inspiration/ expiration gas pathway for the delivery and the discharge of anaesthetic and respiration gases to and from the patient and an adsorption filter disposed in this common pathway, for the adsorption and desorption of anaesthetic gas. A second pathway, which bypasses the adsorption filter, is also provided for the delivery of anaesthetic and/or respiration gases to the patient without passing through the adsorption filter. Practically, the efficiency (i.e. the percentage of expired anaesthetic retained by the filter) of the adsorption filter will be required to be fixed at less than 100% (typically 80%). Some anaesthetic within the expired gas will then always pass through the filter to be lost from the respiration system. This is necessary in order to make the system more responsive to user required changes in the concentration of anaesthetic to be delivered to the patient.

[0003] It is an aim of the present invention to provide an anaesthetic delivery system in which the amount of anaesthetic retained from the expired gas can be varied on demand.

[0004] This is achieved by the anaesthetic delivery system according to and characterised by claim 1. By providing a source of flushing gas which is adapted to flush anaesthetic from the filter element and away from the patient, i.e. without being taken up by the patient, the amount of anaesthetic retained in the system may be varied. Furthermore by controlling the amount of flushing gas passed through the filter some or none of the retained anaesthetic may be allowed to remain within the filter element for subsequent supply to the patient. Additionally, the anaesthetic filter element may be made 100% efficient as flushing will rapidly remove unwanted anaesthetic from the element as and when required.

[0005] Preferably, the respiration gas may be used as the supply of flushing gas and may be controlled to flush the retained anaesthetic into the expiration line at a site downstream of the filter element, (where downstream and upstream are used herein to describe locations with respect to the direction of flow of the relevant gas). Thus existing components of the known anaesthetic delivery system may be used so that the number of additional components required to provide the system of the present invention may be reduced. By flushing the anaesthetic into the expiration line after the filter element the existing apparatus for preventing exhaled anaesthetic from entering the immediate environment may be employed.

[0006] Usefully, the supply of flushing gas may be provided during the expiration phase of a patient's breathing cycle to thereby lower the risk of flushed anaesthetic being taken up by the patient.

[0007] An embodiment of the invention will now be described, by way of example only, with reference to the drawing of the accompanying figure of which:

Figure 1 shows a schematic representation of a system according to the present invention.

Figure 2 shows a modification of the system of Figure 1 to provide an alternative flushing gas system.

[0008] Considering now Figure 1, an anaesthetic delivery system includes a patient respirator 1 operably connected to an anaesthetic gasifier 2, which gasifier 2 may alternatively be disposed integral with the respirator 1. Also included is a common inspiration/expiration gas line 3 for the delivery and the discharge of anaesthetic and respiration gases to and from a patient 4. An adsorption element 5, which contains an adsorption material 6 such as carbon in the form of wood or coconut shell charcoal for the adsorption and desorption of anaesthetic gases, is arranged in the common line 3. The line between the patient 4 and the adsorption element 5 is partially divided into an inspiration branch 7 and an expiration branch 8 and a carbon dioxide absorption filter 9 is placed in the inspiration branch 7. One way valves 10,11 are disposed in the inspiration branch 7 and the expiration branch 8 respectively with the one 11 in the inspiration branch 7 being positioned downstream of the adsorption element 5, between it and the filter 9. The free end of the common line 3 is formed into a Y-coupling, with one branch 12 being connected via the respirator 1 to an evacuation system (not shown) for the expired gas, and with the other branch 13 being connected to the respirator 1 for delivering, as needed, fresh respiration gas to the patient 4. The delivery system further includes a gas line 14 for delivering gaseous anaesthetic from the anaesthetic gasifier 2 to the inspiration branch 7 downstream of both the anaesthetic adsorption element 5 and the CO_2 filter 9. A further gas line 15 is connected to the line 13 and to the respirator 1 for delivering, as needed, fresh respiration gas to the patient 4, by-passing the element 5.

[0009] A gas line 16 is provided to conduct a specimen of inspiration gas to a measuring stage 17. A signal corresponding to the concentration of anaesthetic in the inspiration gas is supplied by the measuring stage 17 to a controller 18 which operably connected within the system to physically control the delivery of respiration and anaesthetic gases dependent of the signal from the measuring stage 17 in order to achieve a desired gas

mixture at the patient 4.

[0010] A gas by-pass line 19 is also provided which, when the controllable valve 20 is open, permits gas in the expiration line to be conducted to the evacuation system without passing through the adsorption element 5.

[0011] The controller 18 is also adapted to control the operation of the valve 20 to open the valve during an expiration phase of the patient's breathing cycle when respiratory gas is supplied as a flushing gas through the element 5 via the lines 13 and 3 in a manner to ensure that the valve 10 does not open. The one way valve 10 may, for added safety, be replaced with a controllable valve similar to that 20 in the by-pass line 19 and operable by the controller 18 to close during the expiration phase in which flushing gas is to be supplied.

[0012] During a normal respiration cycle the valve 20 is closed and expiration gas must then pass through the element 5 during the expiration phase. The anaesthetic gas, supplied during a previous inspiration phase, which the patient 4 expires is then adsorbed by the filter material 6 of the adsorption element 5 whilst the remainder of the expiration gas passes through the common line 2 and the branch 12, via the respirator 1, into the evacuation system. Only in the inspiration phase of the respiration cycle is respiration gas supplied from the respirator 1, via the common line 2 and, because the one-way valve 11 is in a blocking state, the inspiration branch 7 to the patient 4. Inspiration gas thus passes through the adsorption element 5 where the previously adsorbed anaesthetic gas is desorbed and mixes with the respiration gas to be supplied to the patient 4.

[0013] When the element 5 requires flushing, for example when a reduced concentration or no anaesthetic is required, then during the appropriate expiration phase or phases the controller 18 opens the valve 20 to couple the by-pass line 19 into the system so that gas flowing in towards the element 5, from the patient side by-passes the element 5. Respiratory gas is supplied from the respirator 1 during these expiration phase or phases and passes through the element 5 at a pressure which will not cause the one-way valve 10 in the inspiration branch 7 to open. This respiration gas, together with the anaesthetic desorbed from the element 5 is thus caused to pass through the by-pass line 19 and into the evacuation system together with the expired gas from the patient 4.

[0014] Figure 2 shows the delivery system of Figure 1 modified to include an alternative flushing system. In Figure 2 the components that are common to both the embodiment of Figure 1 and that of Figure 2 are given the same reference numerals. Considering now Figure 2, a dedicated source of flushing gas 21, which may for example be an cylinder of pressurised air, is connected via a one way valve 22 to the common gas line 3 at a location such that flushing gas will pass from the source 21, through the material 6 of the adsorption element 5 towards the respirator 1 and away from the patient 4, i.e. in the normal flow direction of the expiration gas. When flushing of the element 5 is required gas from the source 21 is forced through the element 5 during an expiration phase of the patient's breathing cycle to remove retained anaesthetic therefrom into the evacuation system together with the expired gas.

[0015] A person skilled in the art will also appreciate that the flushing gas supply 21 of Figure 2 may also be placed on the opposite side of the element 5. In this case the by-pass line 19 and valve 20 of Figure 1 may be added and operated in a manner analogous to the above described situation where flushing gas is supplied from the respirator 1.

[0016] Although the invention is described herein with reference to a so called "open-loop" delivery system where expired gas is not recirculated and is passed out of the system it will be appreciated by a person skilled in the art that the invention may also be used in so called "closed-loop" systems where expiration gas is recirculated to be re-used by a patient. For example considering the embodiment of Figure 1, the expiration line 12 downstream of the adsorption filter element 5 may be made selectively couplable to the inspiration line 13 upstream of the adsorption filter element 5 to provide a closed-loop ventilator system when the lines 12, 13 are coupled.

Claims

1. An anaesthetic delivery system comprising a ventilation means (1) having an inspiration gas pathway (13,3,7) for conducting inspiration gas to a patient (4) and an expiration gas pathway (8,3,12) for conducting expiration gas away from the patient (4); and a filter element (5) serially connected to both the inspiration and the expiration gas pathways being adapted to retain an anaesthetic from expiration gas passing there through and to release retained anaesthetic into inspiration gas passing there through **characterised in that** there is further provided a supply of flushing gas (1,21) communicable with the filter element (5) to flush the retained anaesthetic from the system without passing to the patient (4).

2. A delivery system as claimed in claim 1 **characterised in that** the supply of flushing gas (1,21) is connectable to the inspiration gas pathway upstream of the filter element (5).

3. A delivery system as claimed in claim 2 **characterised in that** the ventilation means (1) is adapted to also act as the supply of flushing gas.

4. A delivery system as claimed in claim 2 or claim 3 **characterised in that** there is further provided a bypass gas pathway (19) co-operable with a valve means (20) to controllably couple and decouple the

filter element (5) from the expiration gas pathway (8,3,12) and in that the supply of flushing gas (1,21) is operable to flush the retained anaesthetic into the decoupled expiration gas pathway.

5. A delivery system as claimed in claim 1 **characterised in that** the supply of flushing gas (21) is adapted to direct flushing gas through the filter element (5) in the direction of flow of the expiration gas there through.

6. A delivery system as claimed in any preceding claim **characterised in that** the supply of flushing gas (1,21) is operable in timed relation with a patient's breathing cycle to direct a pulse of flushing gas through the filter element (5) during an expiration phase of the breathing cycle.

7. A delivery system as claimed in claim 1 **characterised in that** the expiration gas pathway downstream of the filter element is couplable to the inspiration gas pathway upstream of the filter element to provide a closed-loop ventilation system.

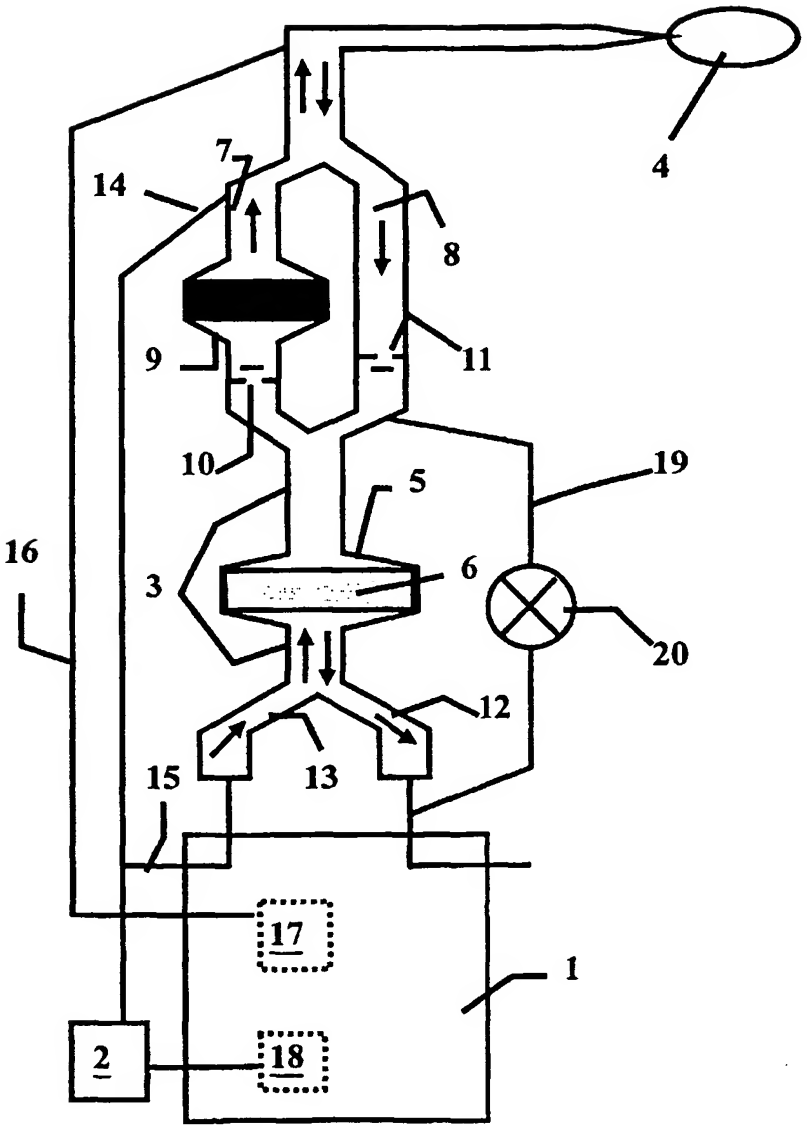

FIG. 1

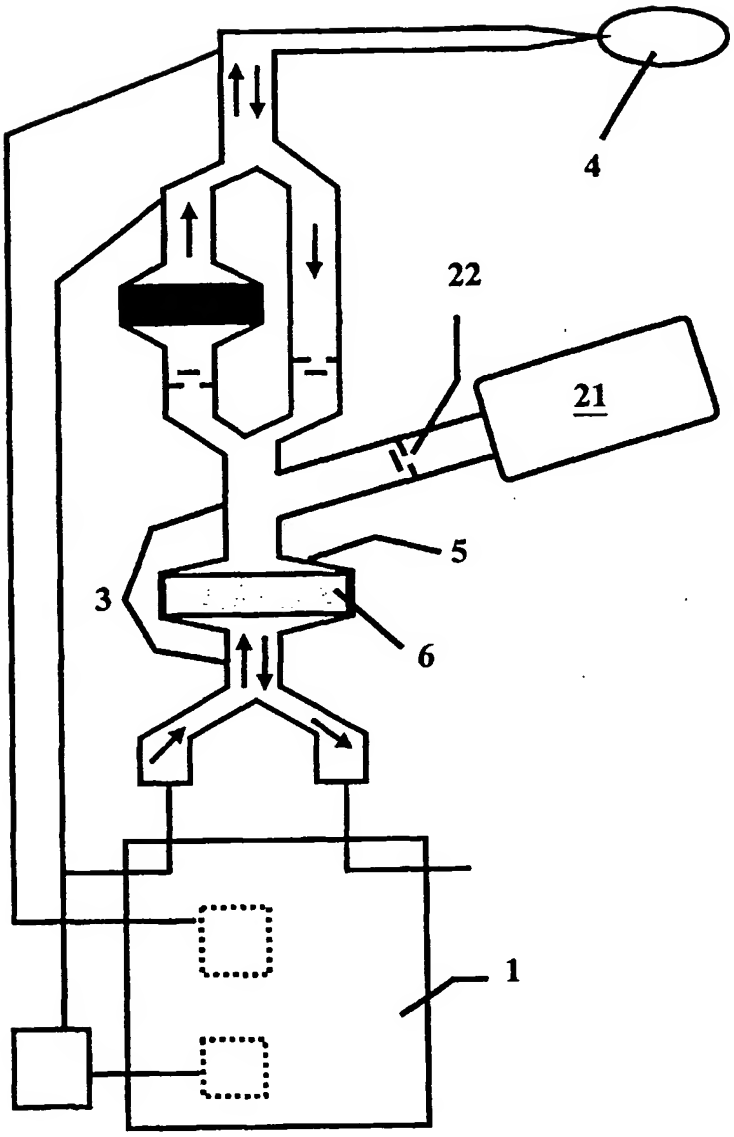

FIG. 2